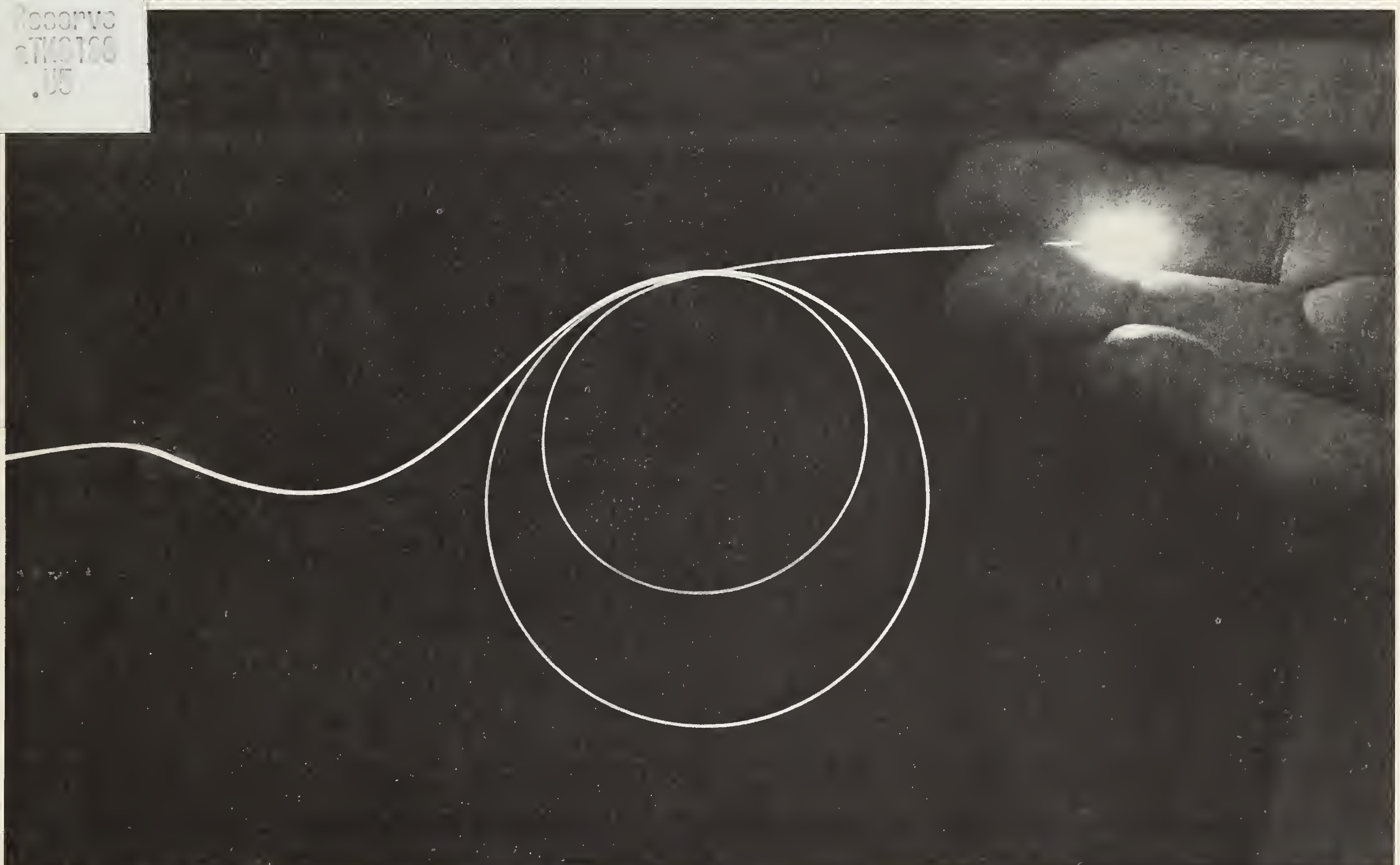
Serving Telephone Subscribers In the Year 2000

U.S. Department
of Agriculture

Rural Electrification
Administration



Serving Telephone Subscribers In the Year 2000

The material in this booklet was prepared by REA telephone program staff members Claude F. Buster, Jr., Sharon Daley, Anthony H. Flores, and Frank H. Norris.

Contents

Introduction

What kind of telephone services will rural telephone systems be offering their customers in the year 2000? Many experts in the telephone industry believe that there will be more changes in the next 10 years (1977 to 1987) than the industry has experienced since its inception more than 100 years ago. To be ready systems must anticipate the changes which logically will occur during the next 25 years.

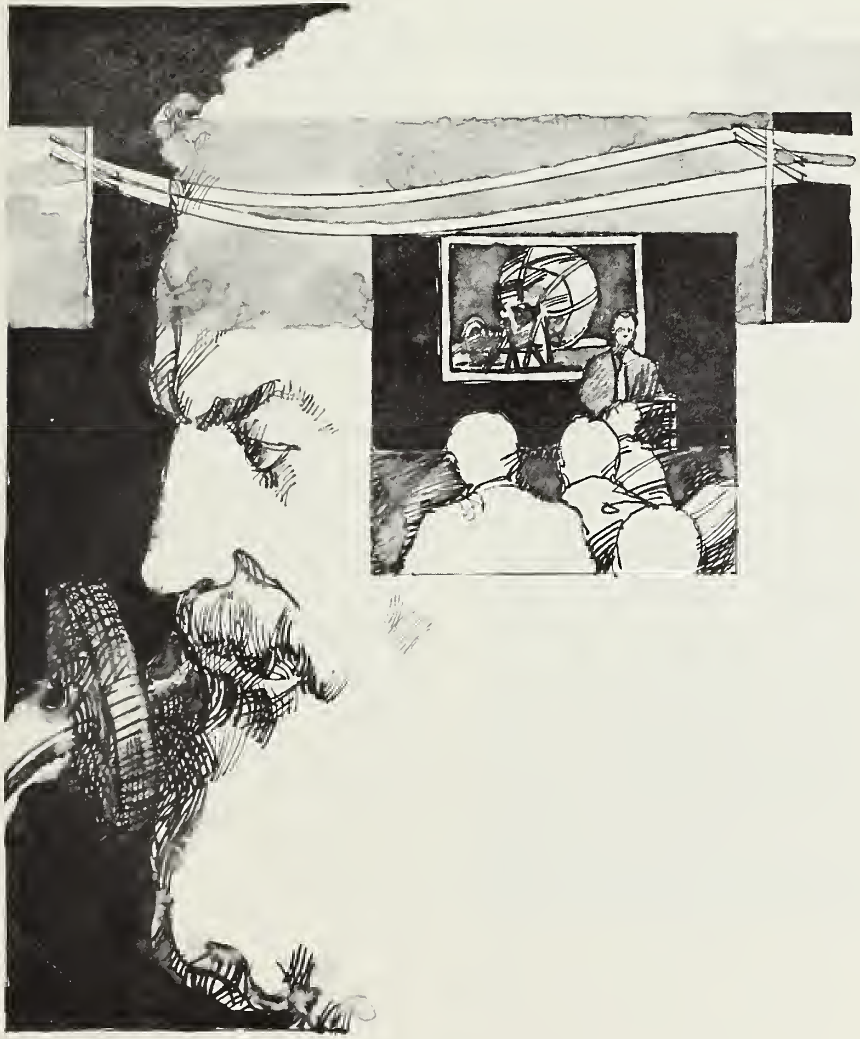
It is essential for the small telephone company to adapt to these changes if it is to survive. The job can be done, but we must anticipate and react to the many changes which are now emerging and will be amplified from now until the year 2000.

Some of the changes telephone experts see:

1. Rapid technological advancement (which will be discussed in this booklet).
2. Regulatory lag — caused by the failure of the regulatory bodies, both Federal and State, to keep pace with the astonishing technological advances that affect the industry.
3. The introduction of competition by those who feel that it is the best form of regulation.

Rural telephone systems must determine how they can best use the technological advances, how they can work within the regulatory lag, and how to best serve their customers. But they can't wait until the year 2000 to get ready. Preparations for the year 2000 must start now.

Relating to the Subscriber in the Year 2000



How well telephone systems relate to subscribers in the year 2000 will depend, in part, on how well the systems' directors do their jobs now and in the immediate future.

In *Board Life — Realities of Being A Corporate Director,* Robert K. Mueller points out that "the time a board member devotes to his main areas of responsibility is a matter of good management. At least one-third of a director's time should be spent in monitoring current operations, whereas two-thirds of his time should be spent in planning the long-term viability of the business."

Unfortunately, he laments, "The average board usually spends 80 to 90 percent of its time on current operations and details." This is true with many REA borrowers. Often, managers and boards are so preoccupied with day-to-day problems and decisions that they become victims of the following rule: Short-term problems drive out long-range planning.

Proper forecasting and planning 5 or 10 years in advance always have determined a telephone system's continuing ability to meet the expanding needs of its members and subscribers.

Today, it is management's business to be a manager of change. As a result, the fundamental rules of the game have changed. Future planning worthy of the name must go far beyond the arbitrary 5-year limit of planning done in the past. It must encompass more than the physical plant facilities included in an area coverage design. It must deal not only with the changing technology, but, more importantly, with an even faster changing factor—the telephone customer-member.

As a consequence, system planning has acquired a new importance. Such an importance, in fact,

that it must be handled by the board of directors. It cannot be delegated.

There are those who say no one can accurately predict the future. So they don't even make the effort to foresee what the probable impact of decisions and resources committed today will be.

This may be true. But we can project what is likely to happen. Additionally, a board and manager working together can decide what kind of a future they want for the system and set out to achieve it.

For telephone systems, two types of planning are needed today to prepare to meet the needs and demands of the subscribers of the year 2000.

First, short-range or operational planning is needed for a 5-year period. It should detail year-by-year subscriber forecasts, operating budgets, cash forecasts, and construction cost estimates. It should also include a pro-forma balance sheet at the end of the fifth year to determine where the system stands after committing its resources to implement such a plan.

Second, the system must have an idea of what its subscribers will be like in the year 2000. Who are they? What will they want? What will they be able to afford?

Certainly, we will need operational planning on an improving scale in the years ahead. But directors and managers must recognize that forecasts of the future have limitations. Their time span of future projection, for instance, is often too short. Their orientation is too technical, and their frame of reference too confined to historical rates of achievement. This makes it difficult to relate to a future group of subscribers for which no precedent exists.

Each director has an unmistakable obligation to marshall the system's resources (financial, physical, and human) required to implement a legitimate forecast. But responsibility *starts*, rather than stops, there.

It is up to the directors to recognize that the system's long-term success or failure depends not just on ability to capitalize on economic opportunities, but ultimately on its capacity to satisfy its subscribers. To do that, a telephone system needs to know all it can about the subscribers, and about the social, political, and economic forces which produce their ever-changing reactions, expectations, and demands.

Forecasting human reactions is, of course, the most inexact branch of an admittedly inexact art. But it is the name of the game for any service business like the telecommunications industry. It must be attempted, and there is a wealth of information available to help in that attempt.

What is known about today's typical telephone subscriber? We know that he is profoundly affected by winds of technological, environmental, social, economic, and political change—winds which are presently sweeping the Nation and the world at unprecedented velocity.

We know that the future holds growth and more growth. The total output of the U.S. economy in dollars of constant purchasing power more than doubled from 1956 to 1976. Goods and services are now being produced at an annual rate of more than 1 trillion dollars. This should double by 1980 and be

about 5 times as great by 1990.

Affluence must be considered. Currently, about 25 percent of all U.S. families have annual earnings exceeding $15,000. By 1980, it may be 46 percent. By 1990, families with incomes exceeding $15,000 (in 1976 dollars) will number well over 40 million and account for close to 60 percent of all families.

The subscribers of the 1980's will be younger, more affluent, more leisure-oriented, more impatient with inconvenience, better educated and sophisticated, yet not necessarily more knowledgeable or more interested in the facts of business life.

Attitudes toward business have become less favorable among certain groups of citizens. Therefore, directors and managers today are faced with many problems. Inflation, high interest rates, scarcity of materials, higher wages, pressures related to the interconnection of customer-owned equipment, extended area service . . . all these factors have an effect on revenues. When we look ahead to the year 2000, one can see more problems such as the growing size and complexity of business and the growth of new issues such as consumerism, environmental and social responsibilities. All of these concerns will require the involvement of boards of directors of rural telephone systems.

What do these major changes in American society mean in the way systems are managed? Just this: If systems are to make the future a successful one—as they must—their plans are going to have to win enthusiastic member acceptance. And this means that those plans will have to be altered where necessary to meet the rising expectations of subscribers in the year 2000.

It also means systems are going to have to be more specific about long-range objectives and ask questions such as these:

- What kind of a telephone system is it trying to build in the long term?
- What kind of a business citizen does it want to be in the community and in the industry?
- What kind of management is desired for the system?
- What does it want to achieve in terms of member involvement?
- What specifically is it doing to develop member interest among young people?
- What is it doing right now to meet these needs?

Directors must address themselves to these questions if they are going to make their operational plans (5-year plan, forecast, or whatever name is used) a reality.

Personnel Needs in the Year 2000

Employees are among a system's most important assets. Personnel should always be considered in any planning. If the system is to keep up with the needs of a more sophisticated customer whose needs demand more complex service, the manager, directors, and employees will have to be top-notch people.

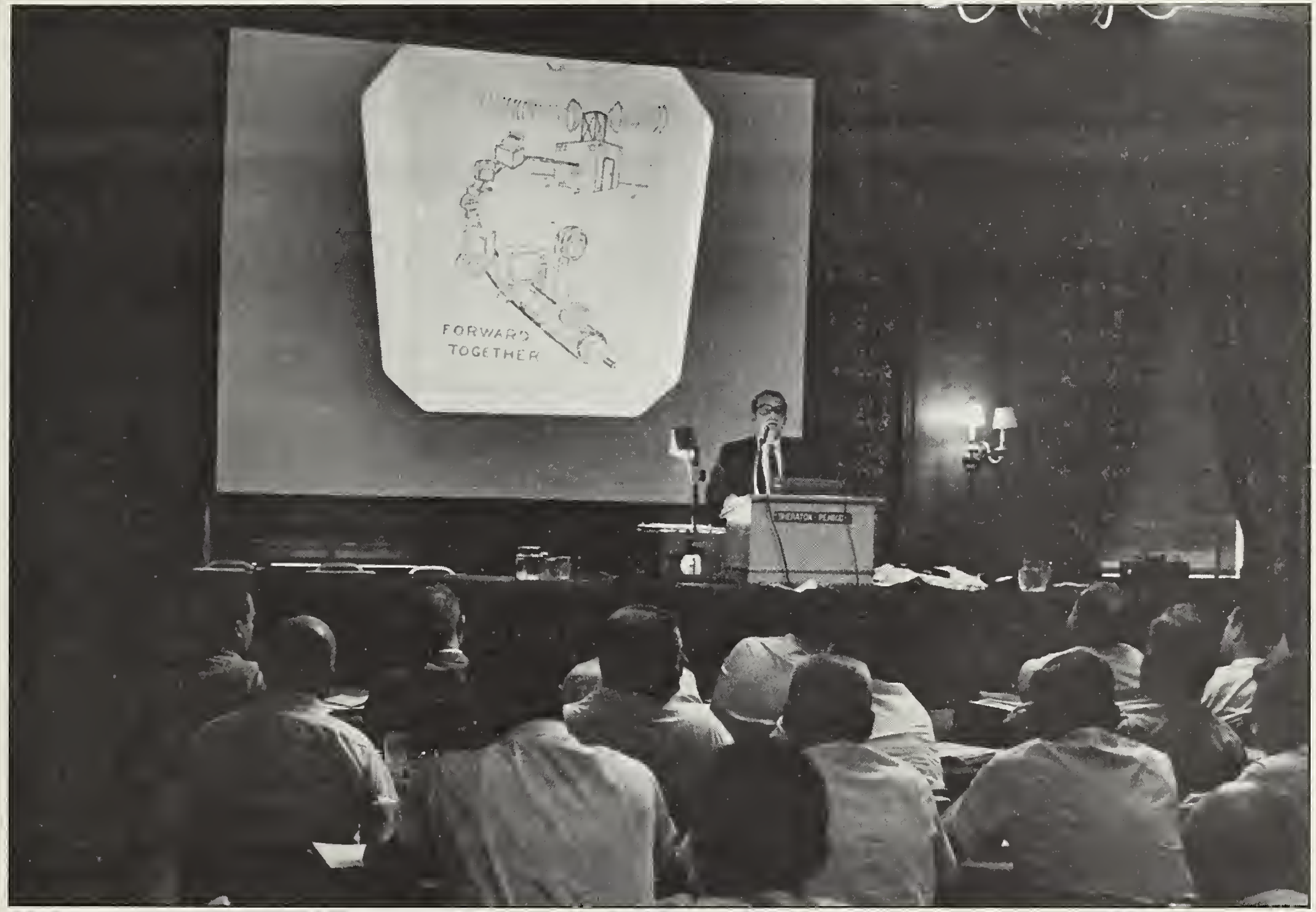
The training of employees to become skilled communications consultants is most important to the success of meeting competition. Salaries may have to be raised in order to attract skilled personnel. No director likes to think of higher operating costs. But highly qualified personnel can account for savings in other areas of the operation.

At times directors tend to set salary levels commensurate with those in the local economy. This has been a mistake in the past and will be an even greater mistake in the future as the entire industry becomes more complex.

A telephone system is an integral part of a State, national, and worldwide communications system. The only comparison of salaries that should be made is between those paid by the system and those of others in the telephone industry, not salaries paid to nontelephone people in the local community.

The technological changes taking place now in the telephone industry are greater than ever before. Managers of telephone companies can't expect an unskilled person to install, maintain, or repair the sophisticated electronic equipment used today. Trained craftspersons are the only answer to this problem.

Managers should set certain



Telephone engineering symposia sponsored by REA bring together technical personnel from throughout the industry to discuss new ideas, introduce new concepts.

criteria which applicants for any plant engineering or construction job must meet or exceed. The minimum requirement should be a high school education. Each and every person starting out with a telephone company should have at least a high school diploma. It would be helpful to have more specialized training in telephony. A basic understanding of electricity and electronic circuitry is mandatory.

We no longer live in the days when installers, repairmen, or cable splicers could learn their routine duties by "on-the-job" training. Specific jobs, such as those of a central office and carrier installer/repairman, involving complex and intricate electronics, require continuing study and training in classes, workshops, or seminars.

Computers — Are They the Future of Telephony?

In the not-so-distant future, it will become difficult to separate computation from communications. Even now, the intertwining of the telephone and computer industries is apparent. Computer operators have become dependent upon telephone circuits to produce the connection between the terminal and the central computer.

The 1960's saw the growth of on-line computer services, particularly time-sharing services for airline reservations and bank statement quotations. Yet, this is by no means a one-way dependence. The telephone industry depends on computers, and the computer industry depends on the telephone industry.

The telephone industry today employs computers to switch both voice and digital messages, monitor toll usage, perform billing and accounting, design its plant, and send its telecommunications satellites into orbit. There is an overlap or interdependence between this industry and the computer industry. Where can it lead us? Let's take an imaginative (but quite feasible) look at the year 2000!

Some forecasters paint nothing but gloomy pictures of the future for us. One such image shows the highways and airways constantly jammed. The air will have become poisonous, the debris from accidents will litter the roadways, and the supply of energy will have been dissipated to such a level that the road ahead will appear to come to an abrupt end.

However, this need not be our future. With the development of visual communication and the improvement of audio communication, travel can be significantly reduced. Many businesses already are using "teleconferences" to cut down on high travel costs. The future holds a vast expansion of this type of system for private individuals.

A computer terminal with a telephone link to the desired central computer will be located in every home. Shopping, for instance, may be done with a telephone link to the supermarket. One could scan a list of available goods and prices at several shops on the home terminal and then use the terminal to place the order. The central computer would then record the bill. This would enable the customer to avoid the ex-

Data display and printout sets are linked by telephone to central computer. Service capabilities of rural telephone systems have grown with the availability of computer-based services.

asperation of a fruitless search for hard-to-find merchandise.

In addition to shopping, home banking will be possible by means of a telephone connection to the bank's computer. Every day, week, or 2 weeks, according to the company, a paycheck may be deposited into a customer's account. A portion of the wage will be transmitted straight to various tax departments by the employer. One may ask for a printout of his or her account at any time. This statement will include any outstanding bills such as rent, groceries, or utilities. One may then pay these bills by instructing the bank computer to transfer the amount of funds from his account to the account of the creditor. Loans, too, could be made through the home terminal. The bank's computer could review an applicant's credit rating and assist the loan officer in processing his loan application.

Just as it will be possible to do accounting by automation, it will be possible to sound out public opinion with comprehensive polls on a frequent or continuous basis. This could possibly be done with a push-button phone. The computer would ask the questions with a "human" voice. The recipient would then respond by pressing a number on the phone. Vast quantities of public opinion data could be collected in this way.

Eventually voting at home may become possible. Each morning one could vote for or against each issue presented to him on the screen of his home terminal. The Congress of the United States would be better informed on the thinking of the citizenry. Each citizen of the United States would have to become more knowledgeable on the issues and responsible for his opinions and decisions.

We have merely skimmed the surface of the vast pool of possibilities the telephone industry has to offer us in the future. This imaginative investigation is not a portrayal of individuals imprisoned in a home or office cubicle, their only contact with the outer world being a voice from a speaker or a face on a viewscreen. On the contrary, it would be a society enriched through the full utilization of our presently existing technological abilities.

Central Office Switching Equipment "Step By Step" Today — Electronic Tomorrow

In days gone by, switching was completely manual. To make a telephone call, the caller would first ring the operator. The operator would then choose the correct line and plug it into the jack of the requested party. This switching technique quickly became obsolete as telephone companies increased their number of subscribers. There were entirely too many lines and jacks to be humanly handled with any kind of speed or accuracy.

Dial switching was developed to cope with this problem. It is still predominant in rural telephone systems. Every phone is equipped with a dial panel. In its simplest form the dial on the telephone directly drives an electromechanical switch to a level of a wire bank corresponding to the digit dialed. Thus, if a subscriber dials a "9", the switch will be driven to level 9. Each digit dialed directly positions a switch until a train of switches is aligned to connect the calling line to the called line. Thus the name "step by step" switching.

Compared with the obsolete manual method, dial switching may appear to be sophisticated and efficient. In light of present technology, this is far from the truth. With the aid of electronics, switching could be relatively free of mechanical failures and costly maintenance. Many large telephone companies are currently replacing their central offices with the electronically based "common control" switching. This type switching equipment is comprised of two parts, the trunk frames over which the subscribers talk to each other and the common circuitry unit. A trunk frame is a multi-subscriber line termination which is connected to the common circuitry unit for switching purposes. After the digits of a telephone number are received, the common circuit unit sets up a connection between subscribers. After the connection (switching) is completed, the common circuit unit is released and is then free to assist in connecting other subscribers.

Presently, switching systems

use mechanical relays. Some of the newer switching equipment has eliminated mechanical relays. A method called "digital switching" has also been introduced.

In January 1976, the Bell system put the world's largest and most advanced electronic switching system into service. While it can switch four times as many calls as the best electromechanical system, it costs only a third as much to maintain. By the end of 1978, Bell expects to have at least 20 of these systems in operation.

The Bell system was not alone in the development of a trunk digital switching system. The Continental Telephone Corporation put a digital telephone switching system into service in Ridgecrest, California, on March 26, 1976. This system is much smaller in size than Bell's and was designed to meet the needs of the independent telephone industry.

We see a great deal of activity by central office equipment manufacturers in the application of digital switching in offices designated for the class 5 category. Class 5 offices are on the bottom "rung" on the nationwide switching system, the one to which residential subscribers are connected. Ninety-eight percent of all rural telephone offices are in class 5. At least three manufacturers expect to be in the field trial stage in 1977 and to be in full production by 1978. The first digital switches to be placed on the market will have up to about 6000 lines (suitable for small offices). Several other manufacturers are applying digital switching to PBX trunks, tandem, and toll recording.

Manufacturers of telephone equipment have also developed a more sophisticated version of common control switching in which the common circuitry unit is referred to as a processor. This processor, a large computer, has the capability of deciding the best way to connect subscribers. Being

Electronic switching systems help to meet the growing demands for telephone service by handling more calls at a faster rate, being freer of mechanical failure and costly maintenance, and having greater capacity for marketable services than dial switching.

a computer, the processor also has the capacity for many marketable switching services, such as speed calling, call waiting, call forwarding, and conference calling. Finding trouble throughout a telephone system also can be done more efficiently with the aid of a processor. The processor self-scans the entire system, sending an alarm at the indication of the slightest trouble or some fault.

Services and updating are made available through modification of the computer memory and through program changes. The switching in some toll equipment for toll and subscriber loops is of the totally electronic common control type. Although this thoroughly sophisticated equipment is priced higher than other switching equipment at the present time, the cost of the totally electronic office should follow the trend of all electronics, becoming less expensive as time goes by. As the toll network becomes more complex, it will require input to match. This means that small telephone companies should become more electronically oriented in order to better interface with the toll network.

The outlook for switching is a good one. Many marketable services will be offered through advancing electronic technology. In addition to speed calling, call forwarding, call waiting, and conference calling, telephone companies will be able to offer services still unheard of by simply reprogramming the processor-computer. Right now, a completely electronic office is a steep investment, but it is one which will undoubtedly prove profitable in the future.

Carrier: Analog Today — Digital Tomorrow

Up until a few years ago there was only one way additional circuits could be obtained on a basic telephone cable: by the use of additional pairs. This meant new cables had to be added; an inefficient and expensive way to expand.

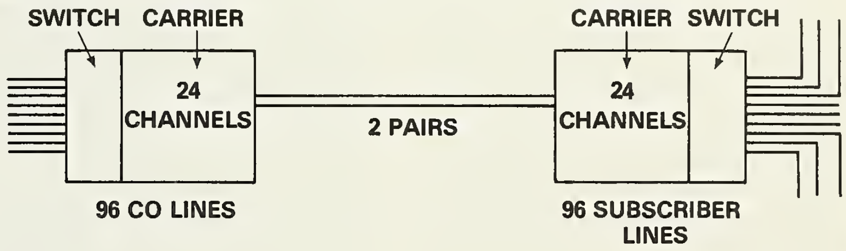
Only a small part of the frequency range of the telephone line is utilized by a voice circuit over a pair of wires. Therefore, by separating several voice frequency channels on the same pair of wires, it is possible to transmit several conversations at the same time without interference. In this way, use of many voice channels over the same telephone line is achieved by carrier systems.

One way in which carrier systems have done this is by frequency translation. Essentially, this method permits several two-way conversations to occur on the same pair. Up to 16 conversations can be held on such a pair with certain carrier systems.

The carrier signal is usually an alternating current of constant frequency. The voice frequency message is superimposed on the higher frequency carrier signal. Thus, the word "carrier". Each carrier must be assigned to a different frequency for transmission over the same telephone line. Since conversations are two-way, each carrier-derived circuit will require two carrier frequencies for operation over one wire pair.

Filters are used in carrier systems to achieve frequency separation. They are designed to pass only the frequencies of the particular channel and to exclude all others. Therefore, different carrier channels using the same wire cannot interfere with one another. This type of carrier is called "analog".

Telephone carrier communications up until a few years ago took place through analog type carrier. This analog carrier wave varies constantly according to the changes in speech signals. Systems of this kind are troubled with noise and crosstalk influence if improperly applied.



DIGITAL SUBSCRIBER CARRIER WITH REMOTE SWITCHING

96 LINES - 2 WIRE PAIRS

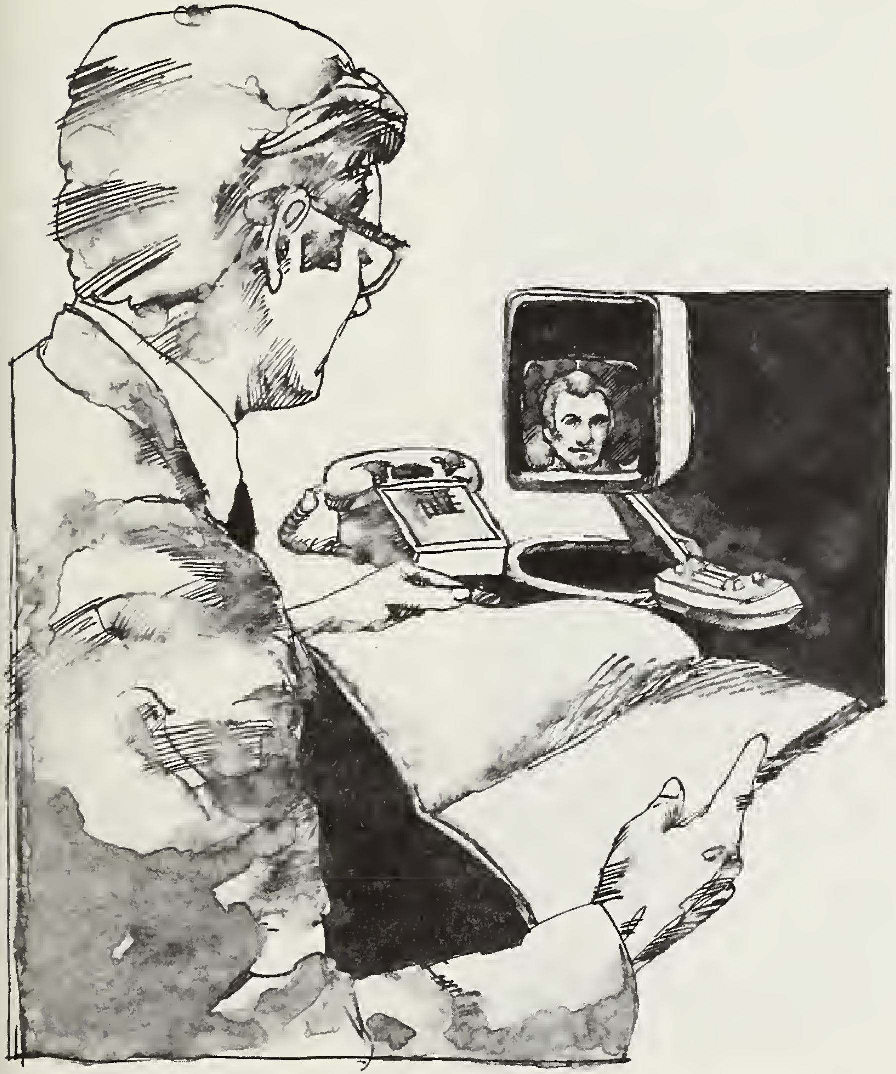
Frequency separation is only one way of providing more than one circuit per wire pair. A time separation technique known as pulse code modulation has also been developed to do the same. This technique requires digital as opposed to analog carrier equipment. Digital carrier is a system of coding speech signals into digital pulses of electricity. Digital transmission actually uses a form of symbols called bits (binary digits). A bit can only be one of two things—a pulse or a nonpulse (a one or a zero). Minor influences can only weaken the signal. Therefore, the information structure remains unchanged until a major agitation is able to change a pulse to a nonpulse or vice versa.

In any operative transmission system the information received (for example at a repeater) differs from the information transmitted as a result of noise and other such influences. Once introduced into an analog system, the disturbance cannot be eliminated. Eventually, the buildup of noise impairs the performance of the system.

On the other hand, digital transmission is not hampered by accumulation of deteriorated signals. The signals are regenerated at the digital repeater. The repeater reads the input, deciphers the message, and uses it to put out a new signal for the next transmission section. Any noise interference from the previous sections is eliminated. The information content of the signal is altered only when the disruption of the signal is so severe that a repeater reads a pulse as a nonpulse. Thus, it can easily be seen that digital transmission systems are more likely to eliminate noise and crosstalk problems in the future.

As our population continues to increase, telephone companies will find it necessary to expand in predominantly rural areas. Burying more cable in order to increase service is a costly venture. On the other hand, the cost of electronic equipment has decreased to the extent that it is competitive with wire plant. Therefore, the same expansion can be done more effectively and at less cost to the company and the subscriber by installing carrier equipment. Changes in existing rural telephone systems can easily be made to accomodate carrier, including digital equipment.

Teleconferencing and the Need for Broadband Transmission Medium

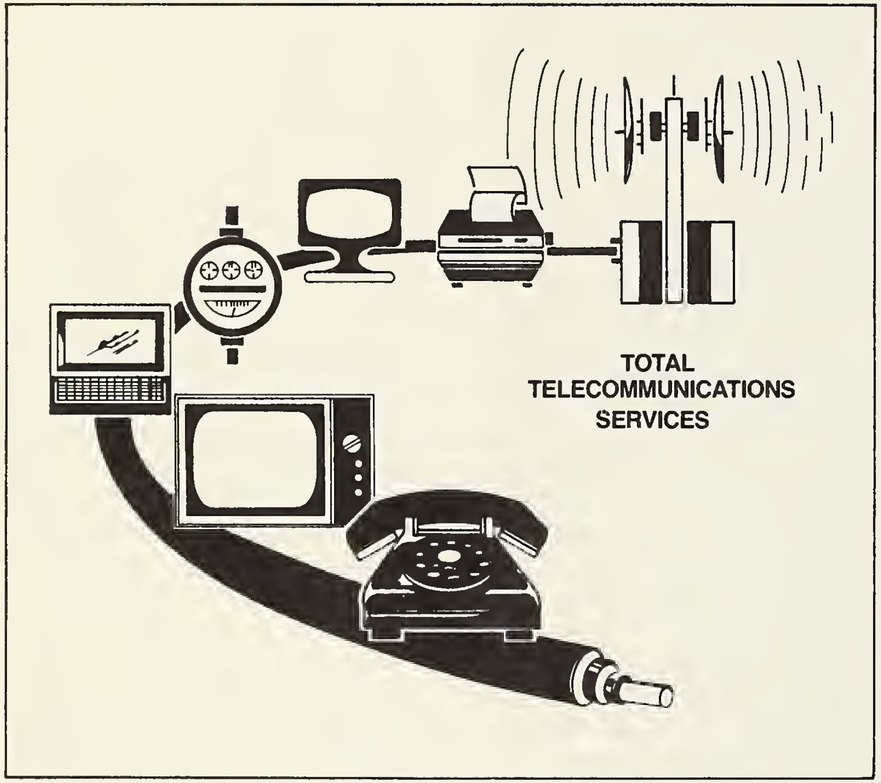


Teleconferencing is a new word that was spawned from telecommunications technology. It is presently being used by a number of businesses throughout the country. It can best be described as a conference between people who are at different locations. Teleconferencing may be purely audio or video with audio. The simplest form of teleconferencing is using extension phones so that several persons at one location may converse with others at another location. Where there are a number of people in a conference room this same type of teleconferencing can be accomplished by means of a speaker-phone (hands free).

Even while waiting for the distribution facilities to make all facets of teleconferencing possible, we are able to provide many types of teleconferencing on our present circuits. Hospitals and medical centers use teleconferencing to show doctors delicate operations being performed at another location. This type of teleconferencing has been termed "telemedicine". In law enforcement, criminals can be identified by means of television and more quickly apprehended. Board meetings can be conducted by means of two-way television teleconferencing. This is becoming more necessary as businesses merge. Board members are able to get together by means of teleconferencing rather than traveling to a common meeting place. Other uses of teleconferencing include providing school for shut-ins, shopping, and conducting just about any kind of business or social engagement one can think of.

While these uses of teleconferencing are available now on a limited basis, they will be commonplace in the year 2000. And there will be innumerable uses unthought of at this time.

A more complex arrangement involves broadcast quality color television with audio. This is truly the next best thing to being there. Existing facilities can provide the audio-type teleconferencing as



well as slow-scan television. Slow-scan television will not provide a motion picture like television, but high resolution still pictures can be produced using available voice frequency circuits. Normal television requires a broadband facility, which means that it must be capable of passing more than the human voice.

A simple illustration of a broadband facility versus the normal voiceband facility can be made by comparing a narrow sidewalk to a huge super highway. The narrow sidewalk can carry pedestrian and bicycle traffic while the super highway can carry large trucks, buses, cars, and just about every type of vehicle imaginable. Likewise, a broadband facility is capable of carrying many voice circuits and several television channels.

Broadband facilities currently in use include overland microwave and coaxial cables which are used to trunk circuits from one point to another. Microwave is also being used from earth stations to communication satellites and back to earth stations all around the world.

While these facilities are adequate for trunking circuits from one point to another, they are just beginning to be used with the flexibility required by telephone companies to offer services to all their subscribers. The use of coaxial cable for providing service to subscribers has begun. Coax has the bandwidth capability to provide not only many voice circuits but also several TV channels.

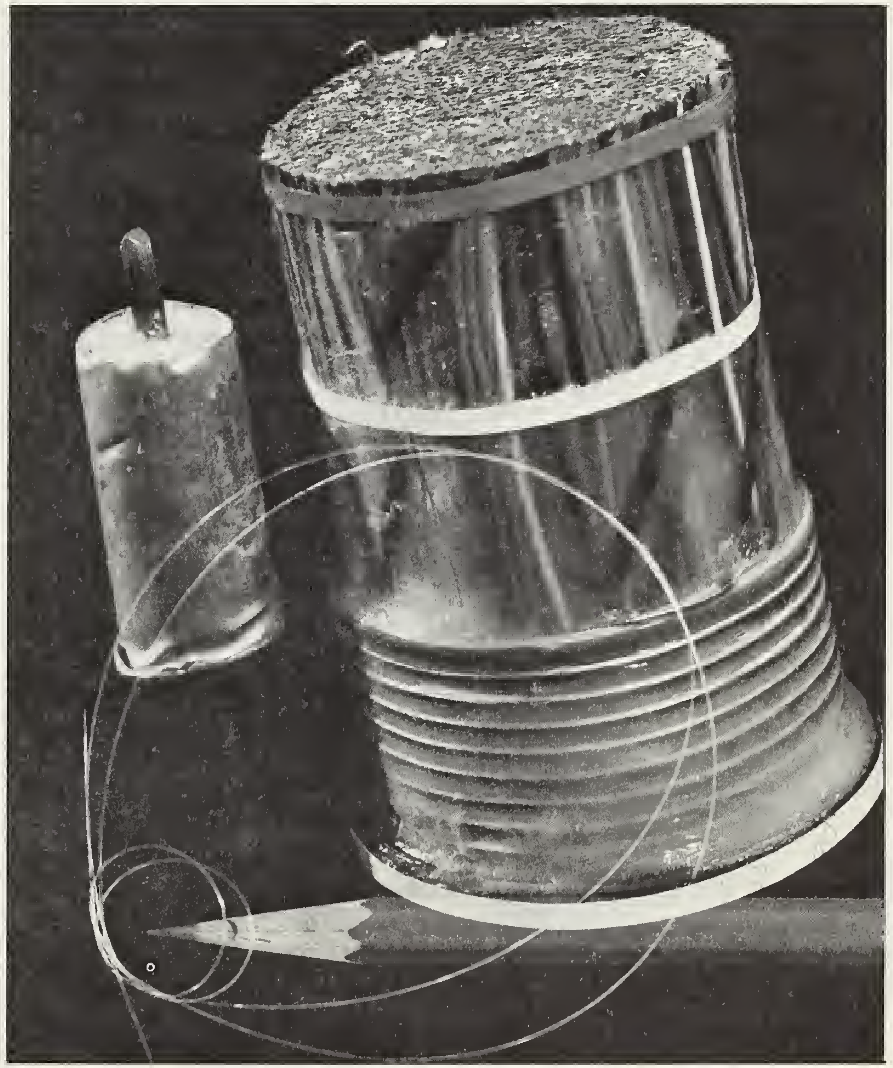
Another technique under experimental use is fiber optics. This is a threadlike substance similar in size to a human hair which has the ability to carry light waves and, since light waves are electromagnetic, can carry all kinds of telecommunications from voice circuits to television channels.

Because of their high frequency, light waves can be modulated by literally tens of thousands of voice channels and many television channels all at the same time!

By the year 2000 it will be commonplace to use fiber optics as a telephone distribution facility. Subscribers will be able to obtain a myriad of services at low cost.

Organizations throughout the world are developing fiber optics. In fact, the Bell System already reports that they have built and tested all the necessary components in a laboratory. They are working on miniature lightwave circuits similar to the integrated circuits of electronic systems.

Bell also reports significant success with lasers, which are important in the use of fiber optics today. Bell is in the process of field testing this equipment. We can safely assume that a working fiber optics system will be a reality within a few years. Once it is a proven quantity, it could well become "the thing" in communications.



Conservation is important in developing technology. Coaxial cable requires far less copper than the bulky paired cable and the fiberoptic requires none. The cost of substituting fiberoptics for telephone cables in major cities might be substantially reduced through the salvage of copper.

Mobile Telephone Service and Paging

Telephone systems have been providing mobile telephone service since the mid-1940's. Until about 1957, this was a manual service, employing the services of an operator. The subscriber would signal the operator by depressing his push-to-talk button and the operator would connect him to the number which he orally requested. Calls to mobile subscribers were made by the operator who signaled their mobile units, similar to land line telephones.

This system worked very well in areas where operators were available. But most rural systems had no operators; hence, an automatic dial system was necessary.

Dial mobile telephone service came about largely through REA developmental contracts in 1957. These systems flourished and later evolved into the present Improved Mobile Telephone System (IMTS), now in widespread use throughout the Nation.

Aside from the high cost, the real limitation of this system is the lack of available frequencies. The FCC has allocated eleven channels in the 150 megahertz band and 12 channels in the 450 megahertz band. The maximum number of trunks for base station channels for a system is eight, which permits up to 470 subscribers to be served on one system. While this number is more than sufficient for the average small independent telephone company, it does not begin to serve the masses in large metropolitan areas. But it is the only type service available at the present time.

Personal paging is another service somewhat related to mobile telephone service and often used in conjunction with it. The subscriber carries a simple receiver on his person. The receiver is activated by a signal from a radio base station when the pager is dialed. There are two radio channels assigned for this type of service. This paging service can also be used on a "piggyback" arrangement with the mobile telephone system. But while the dedicated channels for paging can serve many thousands

of subscribers, the shared or piggyback arrangement can serve only a few hundred.

These pagers come in various arrangements, the most elaborate being a voice pager. The person calling the pager actually gives his message over the telephone so that the person wearing the receiver can hear the message and respond accordingly.

A more popular type is a tone-alert pager which "beeps" to indicate that the person is being paged. Each pager has a special number. It is a standard directory number but it is not ordinarily given out to the public. A businessman with a pager would give his number to his office and his home and other point of contact that would need to call him. When the person is paged by tone only he must go to a telephone and call his office or home to determine who is calling or the nature of the message. Having determined this, he must generally

Paging unit is clipped securely in subject's shirt pocket.Future units may be compact enough for wrist wear or other external placement.

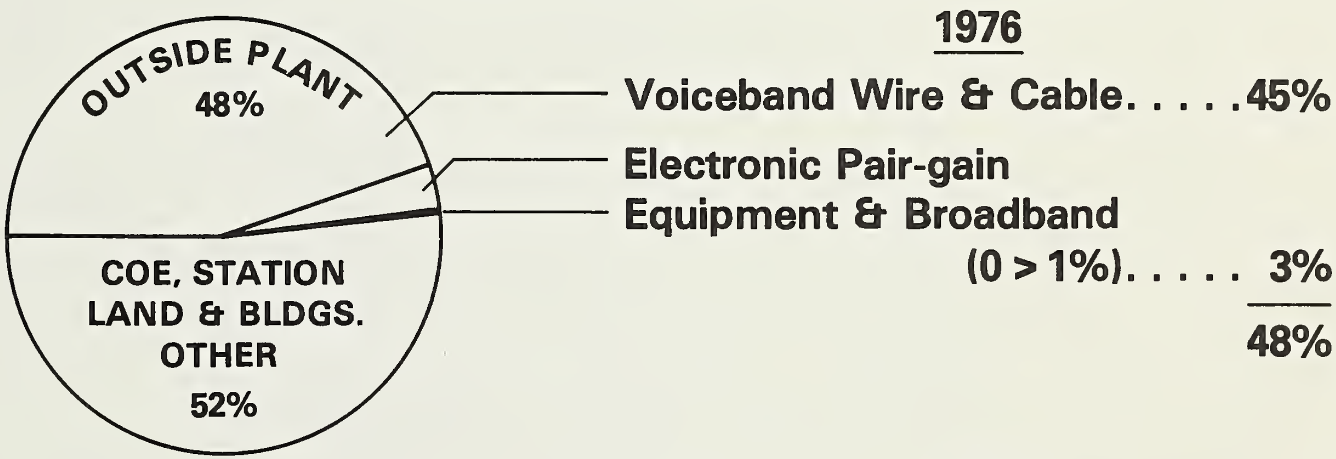
place another call to the person who is trying to get him in the first place. It is important to note here that when the person who has been paged uses a pay phone, he must generally make two calls. This produces additional pay station revenue.

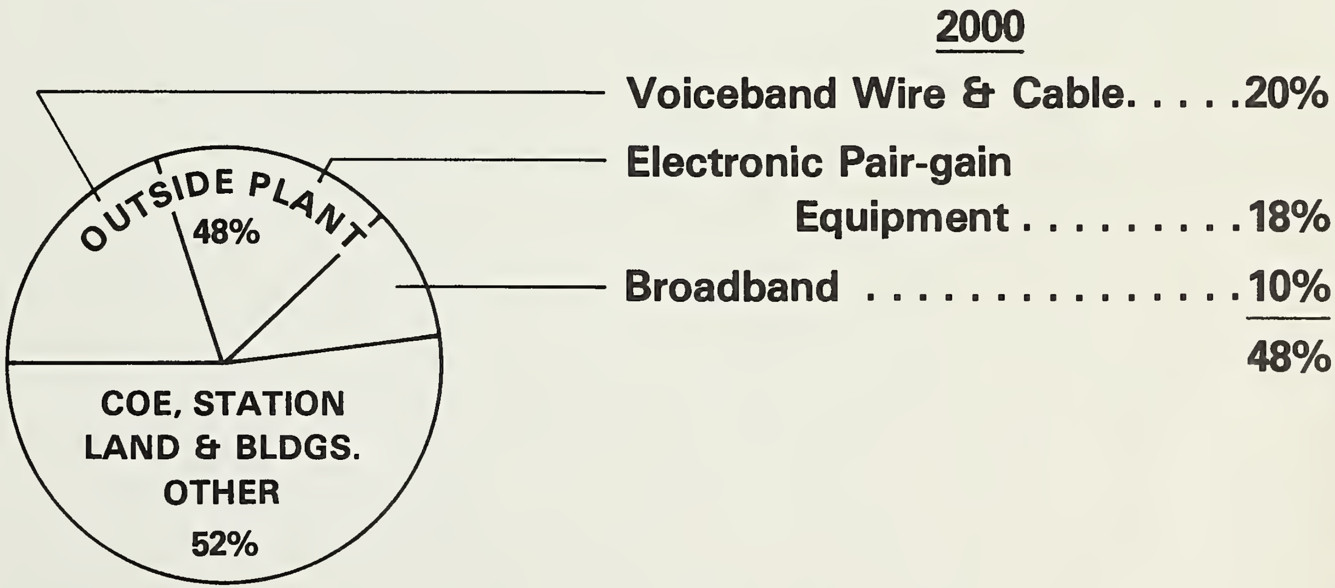
In addition to the voice and tone pagers, other types are available for specific purposes. For example, one would not want to be paged during a conference. So a person could have a pager which has a "memory." He can leave the room and interrogate the pager to determine if he has been paged.

Another pager will vibrate when signaled. This type is particularly useful in areas of high ambient noise. Group paging is available to page a number of persons simultaneously. This might be used to page a force which is working for a common cause, such as policemen, firefighters, etc.

These descriptions cover systems now available. Future systems involving mobile telephone service and paging will likely be much the same except on a greatly expanded basis. Mobile telephone service will operate on higher frequencies with many more channels. Thousands of subscribers will be served rather than just a few hundred. Both the mobile telephone sets and the paging receivers will be much smaller in size and require very little power to operate.

These services will be available to almost everyone because they will be offered at an affordable price. It has been suggested that persons at a very young age will be given a mobile or paging telephone number much like a social security number. This number will be theirs as long as they live or until they discontinue the service.


1976
OUTSIDE PLANT
48%
COE, STATION LAND & BLDGS. OTHER
52%
Voiceband Wire & Cable. 45%
Electronic Pair-gain
Equipment & Broadband
(0 > 1%). 3%
48%


2000
OUTSIDE PLANT
48%
COE, STATION LAND & BLDGS. OTHER
52%
Voiceband Wire & Cable. 20%
Electronic Pair-gain
Equipment 18%
Broadband 10%
48%

RURAL ELECTRIFICATION ADMINISTRATION
REA
U.S. DEPARTMENT OF AGRICULTURE

JUNE 1977